To: Boiler Work Group Chair/Co-Chair
ICCR Boiler Source Work Group

Attached is a table entitled HAPs Selection and Test Methods for Coal-Fired Boilers. The list contains the names of the 189 Hazardous Air Pollutants (HAPs) that have, based on experience, been screened for potential presence in emissions from coal-fired boilers. This preliminary screening has been performed on the list by the Testing and Monitoring Protocol Work Group (TMPWG). This table is being forwarded to the Boiler Source Work Group (SWG) for review and comment.

The table includes HAPs that may be present in coal-fired boiler emissions. Additionally, a listing of testing methods that have been used and have the potential to quantify the HAPs presence in flue gas emissions are included.

For those HAPs that are not included in the list, a codified reason for their exclusion is provided. Exclusion codes include:

1- Compound is not expected to be emitted from source because basic chemical or physical principles do not favor its existence in source exhaust.

2 - Existing test data indicate that compound is not emitted in significant quantities from source.

Other exclusion codes are included as appropriate.

It should be noted that this table is general in its first draft and represents the extent of the TMPWG's knowledge and experience with emissions from coal-fired boilers. Please review carefully from a standpoint of those HAPs included as well as those HAPs excluded. The subgroup within the TMPWG that is responsible for the development of this table has included a preface that provides the sources of information utilized to develop the table, the rationale for exclusion codes, and the names of the TMPWG contact for the Boiler SWG.

If we can be of service in any other fashion or if you have any questions concerning in the table, please contact the TMPWG's member who is monitoring the activities of your SWG.

The Testing and Monitoring Protocol Work Group member that is responsible for following the Boiler SWG is Tom McGrath. (E-mail “eertommc@hotmail.com”)

HAPs Selection and Test Methods for Coal-Fired Boilers

Under section 112(n)(1)(A) of the Act, Congress mandated that the Environmental Protection Agency (EPA) "…perform a study of the hazards to public health reasonably anticipated to occur as a result of emissions by electric utility stream generating units of … [HAPs] … after imposition of the requirements of the Act." The results of this study have been issued in the following report:
Study of Hazardous Air pollutant Emissions from Electric utility Stream Generating Units -- Interim Final Report United States Environmental Protection Agency
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711
EPA-453/R-96-013, October 1996

The emissions from electric utility coal-fired boilers should be very similar in composition to emissions from industrial coal-fired boilers. The attached table that addresses HAP emissions from industrial coal-fired boilers is based upon emission testing conducted as part of this study. Over 50 emission tests were performed on coal-fired, oil-fired and natural gas-fired utility boilers. The testing to support this study was conducted by the Electric Power Research Institute (EPRI), the Department of Energy (DOE) and the US EPA. A total of 72 HAPs and HAP categories were detected in the emissions from utility coal-fired boilers. These HAPs and HAP categories are identified by either a "blank" or a "3" in the exclusion code column. The list of 72 was pared to 24 HAPs and HAP categories by identifying the HAPs that were "most consistently" detected in the emission test conducted on coal-fired boilers. For the purpose of paring down the list of HAPs and HAP categories, "most consistently" was defined as being present in at least 25 percent (or 5 tests) of the 20 tests conducted on coal-fired boilers. This procedure for identifying the significant HAPs was only utilized for the organic HAPs. An "X" in the left-hand column identifies the HAPs and HAP categories that are included in the pared down list and the exclusion code column is blank.

HAPS Selection and Test Methods for Source Category

Source Category: Coal-Fired Boilers

Instructions:
Place an "x" in column A for each compound which should be included in the list of applicable compounds for the source category. Then, enter the appropriate test method(s) in column E for each of the included compounds.

For compounds which should be excluded from the list, leave column A blank. Then, enter an explanation for their exclusion in column D. A list of exclusion codes is included to simplify this

Exclusion Codes:
1 - Compound is not expected to be emitted from source because basic chemical or physical principles do not favor its existance in source exhaust.

2 - Existing test data indicate that compound is not emitted in significant quantities from source.

3 - Other (Specify)

4 - Other (Specify)

5 - Other (Specify)

Include in List	CAS No.	Chemical name	If excluded, give reason for exclusion (use codes where appropriate)	If Included, give applicable test method(s)
X	75070	Acetaldehyde		Method 0011
	60355	Acetamide	2	
	75058	Acetonitrile	2	
X	98862	Acetophenone		Method 0010
	53963	2-Acetylaminofluorene	2	
X	107028	Acrolein		Method 0011
	79061	Acrylamide	2	
	79107	Acrylic acid	2	
	107131	Acrylonitrile	2	
	107051	Allyl chloride	2	
	92671	4-Aminobiphenyl	2	
	62533	Aniline	2	
	90040	o-Anisidine	2	
	1332214	Asbestos	2	
X	71432	Benzene		Method 0030
	92875	Benzidine	2	
	98077	Benzotrichloride	2	
X	100447	Benzyl chloride		Method 0010
	92524	Biphenyl	2	
X	117817	Bis(2-ethylhexyl)phthalate (DEHP)		Method 0010
	542881	Bis(chloromethyl)ether	2	
X	75252	Bromoform		Method 0010
	106990	1,3-Butadiene	2	
	156627	Calcium cyanamide	2	
	133062	Captan	2	
	63252	Carbaryl	2	
X	75150	Carbon disulfide		Method 0030
X	56235	Carbon tetrachloride		Method 0030
	463581	Carbonyl sulfide	2	
	120809	Catechol	2	
	133904	Chloramben	2	
	57749	Chlordane	2	
X	7782505	Chlorine		Methods 0050, 0051
	79118	Chloroacetic acid	2	
X	532274	2-Chloroacetophenone		Method 0010
X	108907	Chlorobenzene		Methods 0010 or 0030
	510156	Chlorobenzilate	2	
X	67663	Chloroform		Method 0030

HAPS Selection and Test Methods for

Coal-Fired Boilers

Include in List	CAS No.	Chemical name	If excluded, give reason for exclusion (use codes where appropriate)	If Included, give applicable test method(s)
	107302	Chloromethyl methyl ether	2	
	126998	Chloroprene	2	
	1319773	Cresols/Cresylic acid (isomers and mixture)	2	
X	95487	o-Cresol		Method 0010
X	108394	m-Cresol		Method 0010
X	106445	p-Cresol		Method 0010
X	98828	Cumene		Method 0010
	94757	2,4-D, salts and esters	2	
	3547044	DDE	2	
	334883	Diazomethane	2	
X	132649	Dibenzofurans		Method 23
	96128	1,2-Dibromo3-chloropropane	2	
X	84742	Dibutylphthalate		Method 0010
	106467	1,4-Dichlorobenzene(p)	2	
	91941	3,3-Dichlorobenzidene	2	
	111444	Dichloroethyl ether (Bis(2-chloroethyl)ether)	2	
X	542756	1,3-Dichloropropene		Method 0030
	62737	Dichlorvos	2	
	111422	Diethanolamine	2	
	121697	N,N-Diethyl aniline (N,N-Dimethylaniline)	2	
	64675	Diethyl sulfate	2	
	119904	3,3-Dimethoxybenzidine	2	
	60117	Dimethyl aminoazobenzene	2	
	119937	3,3--Dimethyl benzidine	2	
	79447	Dimethyl carbamoyl chloride	2	
	68122	Dimethyl formamide	2	
	57147	1,1-Dimethyl hydrazine	2	
	131113	Dimethyl phthalate	2	
	77781	Dimethyl sulfate	2	
	534521	4,6-Dinitroo-cresol, and salts	2	
	51285	2,4-Dinitrophenol	2	
X	121142	2,4-Dinitrotoluene		Method 0010
	123911	1,4-Dioxane (1,4-Diethyleneoxide)	2	
	122667	1,2-Diphenylhydrazine	2	
	106898	Epichlorohydrin (l-Chloro-2,3-epoxypropane)	2	
	106887	1,2-Epoxybutane	2	
	140885	Ethyl acrylate	2	
X	100414	Ethyl benzene		Method 0010
	51796	Ethyl carbamate (Urethane)	2	
X	75003	Ethyl chloride (Chloroethane)		Method 0030
	106934	Ethylene dibromide (Dibromoethane)	2	
X	107062	Ethylene dichloride (1,2-Dichloroethane)		Method 0030
	107211	Ethylene glycol	2	
	151564	Ethylene imine (Aziridine)	2	
	75218	Ethylene oxide	2	
	96457	Ethylene thiourea	2	
	75343	Ethylidene dichloride (1,1-Dichloroethane)	2	
X	50000	Formaldehyde		Method 0011
	76448	Heptachlor	2	
X	118741	Hexachlorobenzene		Method 0010
	87683	Hexachlorobutadiene	2	
	77474	Hexachlorocyclopentadiene	2	
	67721	Hexachloroethane	2	
	822060	Hexamethylene-1,6-diisocyanate	2	
	680319	Hexamethylphosphoramide	2	
X	110543	Hexane		Method 0030
	302012	Hydrazine	2	
X	7647010	Hydrochloric acid		Method 0050, 0051

HAPS Selection and Test Methods for

Coal-Fired Boilers

Include in List	CAS No.	Chemical name	If excluded, give reason for exclusion (use codes where appropriate)	If Included, give applicable test method(s)
X	7664393	Hydrogen fluoride (Hydrofluoric acid)		Method 13A or B
	7783064	Hydrogen sulfide	2	
	123319	Hydroquinone	2	
X	78591	Isophorone		Method 0010
	58899	Lindane (all isomers)	2	
	108316	Maleic anhydride	2	
	67561	Methanol	2	
	72435	Methoxychlor	2	
X	74839	Methyl bromide (Bromomethane)		Method 0030
X	74873	Methyl chloride (Chloromethane)		Method 0030
X	71556	Methyl chloroform (1,1,1-Trichloroethane)		Method 0030
X	78933	Methyl ethyl ketone (2-Butanone)		Method 0011
	60344	Methyl hydrazine	2	
	74884	Methyl iodide (Iodomethane)	2	
X	108101	Methyl isobutyl ketone (Hexone)		Method 0011
	624839	Methyl isocyanate	2	
X	80626	Methyl methacrylate		Method 0030
X	1634044	Methyl tert butyl ether		Method 0010
	101144	4,4-Methylene bis(2-chloroaniline)	2	
X	75092	Methylene chloride (Dichloromethane)		Method 0030
	101688	Methylene diphenyl diisocyanate (MDI)	2	
	101779	4,4--Methylenedianiline	2	
X	91203	Naphthalene		Method 0010
	98953	Nitrobenzene	2	
	92933	4-Nitrobiphenyl	2	
	100027	4-Nitrophenol	2	
	79469	2-Nitropropane	2	
	684935	N-Nitroso-Nmethylurea	2	
X	62759	N-Nitrosodimethylamine		Method 0010
	59892	N-Nitrosomorpholine	2	
	56382	Parathion	2	
	82688	Pentachloronitrobenzene (Quintobenzene)	2	
X	87865	Pentachlorophenol		Method 0010
X	108952	Phenol		Method 0010
	106503	p-Phenylenediamine	2	
	75445	Phosgene	2	
	7803512	Phosphine	2	
X	7723140	Phosphorus		Method 0012
X	85449	Phthalic anhydride		Method 0010
	1336363	Polychlorinated biphenyls (Aroclors)	2	
	1120714	1,3-Propane sultone	2	
	57578	beta-Propiolactone	2	
X	123386	Propionaldehyde		Method 0011
	114261	Propoxur (Baygon)	2	
	78875	Propylene dichloride (1,2-Dichloropropane)	2	
	75569	Propylene oxide	2	
	75558	1,2-Propylenimine (2-Methyl aziridine)	2	
X	91225	Quinoline		Method 0010
	106514	Quinone	2	
X	100425	Styrene		Method 0010
	96093	Styrene oxide	2	
X	1746016	2,3,7,8-Tetrachlorodibenzo-p-dioxin		Method 23
	79345	1,1,2,2-Tetrachloroethane	2	
X	127184	Tetrachloroethylene (Perchloroethylene)		Method 0030
	7550450	Titanium tetrachloride	2	
X	108883	Toluene		Methods 0010 or 0030
	95807	2,4-Toluene diamine	2	
	584849	2,4-Toluene diisocyanate	2	

HAPS Selection and Test Methods for

Coal-Fired Boilers

Include in List	CAS No.	Chemical name	If excluded, give reason for exclusion (use codes where appropriate)	If Included, give applicable test method(s)
	95534	o-Toluidine	2	
	8001352	Toxaphene (chlorinated camphene)	2	
	120821	1,2,4-Trichlorobenzene	2	
X	79005	1,1,2-Trichloroethane		Method 0030
X	79016	Trichloroethylene		Method 0030
	95954	2,4,5-Trichlorophenol	2	
	88062	2,4,6-Trichlorophenol	2	
	121448	Triethylamine	2	
	1582098	Trifluralin	2	
	540841	2,2,4-Trimethylpentane	2	
X	108054	Vinyl acetate		Method 0030
	593602	Vinyl bromide	2	
	75014	Vinyl chloride	2	
X	75354	Vinylidene chloride (1,1-Dichloroethylene)		Method 0030
X	1330207	Xylenes (isomers and mixture		Method 0010
X	95476	o-Xylenes		Method 0010
X	108383	m-Xylenes		Method 0010
X	106423	p-Xylenes		Method 0010
X	N/A	Antimony Compounds		Method 0012
X	N/A	Arsenic Compounds (inorganic including arsine)		Method 0012
X	N/A	Beryllium Compounds		Method 0012
X	N/A	Cadmium Compounds		Method 0012
X	N/A	Chromium Compounds		Method 0012
X	N/A	Cobalt Compounds		Method 0012
	N/A	Coke Oven Emissions	2	
X	N/A	Cyanide Compounds *1		Modified Method 6
	N/A	Glycol ethers *2	2	
X	N/A	Lead Compounds		Method 0012
X	N/A	Manganese Compounds		Method 0012
X	N/A	Mercury Compounds		Method 0012
	N/A	Fine mineral fibers *3	2	
X	N/A	Nickel Compounds		Method 0012
X	N/A	Polycylic Organic Matter *4		CARB 429
X	N/A	Radionuclides (including radon) *5		Method 114
X	N/A	Selenium Compounds		Method 0012

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United States Environmental Protection Agency
Office of Air Quality Planning and Standards
Research Triangle Park, NC 27711
EPA-453/R-96-013, October 1996

Baseline Air Toxic Emissions from U.S. Navy Coal-Fired Industrial Boilers
Keaton J. McCallister, Naval Facilities Engineering, Service Center
Port Hueneme, California
Presented at the 89th Annual Meeting (June 1996) of the AWMA, Nashville, TN,

Research and Evaluation of Organic Hazardous Air Pollutant Source Emission Test Methods
Larry D. Johnson
United States Environmental Protection Agency, National Exposure Research Laboratory
Research Triangle Park, NC
Journal of the Air & Waste Management Association, Volume 46, December 1996, pp. 1135 - 1148